HDM97

Dialysis Measuring System

User Manual

Attention

Read these safety instructions before using the HDM97

- **Please read the manual before using the HDM97.**
- **Keep away the device from unauthorized persons.**
- **Never use the HDM97 with connected battery charger on a dialysis machine to which a patient is connected.**
- **Operate the instrument only in a dry environment, and do not touch it with damp hands. Ensure that no fluids intrude into the interior of the device or into the sockets at the front.**
- **Apply a protection filter to the nozzle for the pressure measurement .**
- **Avoid a discharge of static electricity over the sockets. It could lead to the destruction of your measuring device. Before touching the sockets and lines that are connected with them, keep an eye on the discharging of static electricity.**
- **Only calibrate the device if you have understood the consequences to their full extent.**
- **Do not open the device.**

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3rd Edition April 2000 Version 2.0

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Delivery extent

The hardware of HDM97 consists of:

HDM97 plus
Combined electrode conductivity / temperature
Flow-through connector for conductivity/temperature probe
Pressure measuring tube
Battery charger
Standard solution conductivity 13,63 mS/cm

The documentation of HDM97 consists of this manual.

If you should miss anything, please contact your supplier.

EC-Conformity Declaration

Hereby we declare that the HDM97 corresponds to the basic requirements for protection according to the guidelines of the board for the assimilation of legal regulations about electro-magnetic compatibility (89/336/EWG) of the member states.
For the rating of the devices in view to their electro-magnetic compatibility the following norms have been used:

Emission:	EN 55022 Class B
Immission:	IEC 801-3 Criterion A
	IEC 801-2 Criterion A
	IEC 801-4 Criterion B

This declaration is responsibly given for

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by

Dipl. Ing. Werner Pfingstmann
Managing director

Hannover, June 10, 1997

Software Service

Your first contact should always be your specialist supplier where your device was purchased. He should be able to help you especially in the early stages, in case any problems arise which you are unable to solve by yourself.

Guarantee directives

The existing product is a technical device which contains only modern electronic components. During the manufacturing exclusively first choice parts are used. Each device undergoes extensive tests before delivery.
IBP warrants that the device is free from defects in material and workmanship for a period of 12 months beginning at the date of delivery. Excluded from the guarantee are damages by improper treatment, inappropriate usage, by connecting to excess voltages, modifications in the device or through risks which the user has to cover by a suitable insurance (fire, water, intrusion, robbery etc.)
All conceivable measures were met to assure the accuracy of this product-documentation. IBP cannot grant any guarantee for the completeness and the accuracy of the software and the documentation. IBP is not responsible for damages (including, but not limited to, damages for loss of business profits, business interruption, loss of data, and other special, incidental or consequential damages) which emerge through the usage of the product by the customer.

About this manual

Documentations about technical products are always a difficult matter. Actually, manuals like this should not be written by a technician, but in the diction of the future user. As a rule, unfortunately, the eloquent layman is missing the background knowledge to describe technical relations correctly. Therefore, in our house, manuals are still written by technicians. We hope indeed that we have been successful in composing a well readable text which at the same time does not leave open any technical questions.

Introduction

HDM97 is an innovative computer processed measuring system with which nine parameters can be measured:

Conductivity
Temperature
Pressure
pH

The device has been developed for the usage on dialysis machines, but is also usable in the labor in the environmental measuring technology.
The handling is uncomplicated and follows the motto: Only the manual is necessary in cases of doubt.

The measured values are displayed numerically.
They can be called up independently of the current display via the serial interface and can be shown or further processed on, for example, a PC.

Connections

Conductivity / Temperature

The conductivity measurement is designed for quadropole technology. Please use exclusively the electrode delivered with the device by IBP.

Pressure

To avoid damages at the pressure probe or inaccuracies in measurement, ensure that no fluids intrude into the device.
We recommend the application of a protection filter.

pH

The input bushes are intended exclusively for pH-electrodes. Other signals may destroy the device.

Charge connection

The charge connection is found at the right side of the device. The connection is provided with 12 V / 500 mA by the included battery charger.

For safety reasons never use the HDM97 with connected battery charger on a dialysis machine to which a patient is connected.

Combined electrode in Hansen-connector

In the flow-through mode the connector is suitable for measuring pressure, temperature and conductivity. In the dip-in mode temperature and conductivity can be measured. The preferential position of the Hansen-connector is vertical, the axial supply shows downward.
In the flow-through mode the axial supply is used as input and the radial supply as output (see illustration). The pressure probe in HDM97 is fastened to the radial connection above the input. Before any measurements you must shake the connector to assure that any air within the system escapes.
For the dip-in mode open the screw cap at the upper end of the connector and
extract the combined electrode. You must not remove the tube covering the probe carrier. Dip the electrode into the media up to a level above the borings in the covering tube. By moving the electrode you assure that the contained air can escape and the temperature is well balanced.

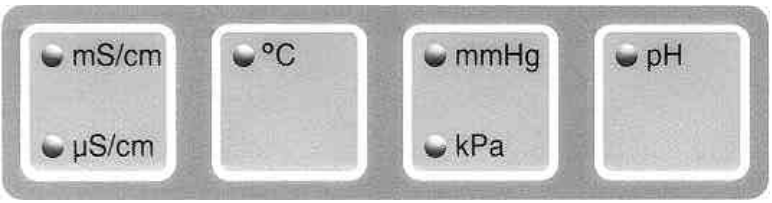
Do not touch the surface of the electrode with your fingers.

Switching on the unit

The unit is switched on and off via the keys I and O.
The unit also switches itself off automatically when the battery is flat.

Main Menu

After switching it on, the device automatically enters the conductivity measuring mode.
By pressing the function keys shown, the required measurement channel will be activated and acknowledged by an acoustic confirmation. The measuring mode selected will be indicated by the relevant LED flashing.



The key for the conductivity measuring mode has two functions. If the conductivity channel is active, pressing this key will change over to the temperature coefficient setting mode. This mode will be indicated by both the conductivity key LEDs flashing.

The keys shown below are used for calibrating conductivity and pH measurement, for balancing pressure measurement, for setting the temperature coefficient, and also for accepting default values.
The Kal key, which shows a calibration curve symbol, will call up or complete the calibration and balancing processes and also the process for accepting default values, and will accept relevant values. The LED integrated into the Kal key indicates the respective process from call-up to completion by flashing.
Using the arrow keys in the calibration mode, the reference solution value for conductivity measurement and the buffer solution value for the pH measurement are changed. Pressing these during the temperature coefficient setting process will select different dialysis machine manufacturers' temperature coefficients. In case the device is in none of the above setting modes, pressing one of the two arrow keys will bring up the HDM97's software version.

Adjustment Key

Up Arrow Key

Down Arrow Key

In case the device is in none of the above setting modes, pressing one of the two arrow keys will bring up the HDM97's software version.

Measurement

Temperature measurement

Pressing function key °C will call up the temperature measuring mode. The temperature value measured will be shown on the display with one digit after the decimal point.
The temperature sensor is suitable for a temperature range from 0 °C to 100 °C. In case this temperature range is not observed, a range message OFL will appear on the display, indicating that the measuring range has been exceeded.
In case error message E11 is shown on the display instead of the temperature value, and an acoustic signal sounds simultaneously, no temperature sensor was found. One reason for this error message is the temperature sensor being defective or incorrectly installed.

Conductivity measurement

By pressing function key mS/µS, you will enter the conductivity measuring mode. The current temperature coefficient will briefly be indicated. Then the conductivity value is shown on the display, depending on the relevant conductivity measuring range, with a maximum of two digits after the decimal point. The conductivity electrode is suitable for measuring conductivity values within a range of 0 – 19.99 mS/cm, which is divided into four conductivity measuring ranges to provide highly accurate measurements.
The internal pressure sensor is suitable for a pressure measuring range of -750 to +750 mmHg, or -100 to +100 kPa. If the measuring range is not observed, a range message OFL, indicating that the measuring range has been exceeded, appears on the display. Depending on the drift of the pressure sensor, the pressure display can vary slightly in the zero point. The balancing function sets the display to zero. However, pressure must not be applied to the sensor in this case. This is reliably achieved achieved

Conductivity Measuring Range

In case a range message OFL is shown on the display, this indicates that the measuring range has been exceeded.
The conductivity measuring ranges are switched automatically. The LEDs integrated into function key mS/µS show the unit used in measuring the conductivity value, e.g. mS/cm or µS/cm.

I	: 0 -	19,9 µS/cm
II	: 0 -	199 µS/cm
III	: 0 -	1,99 mS/cm
IV	: 0 -	19,9 mS/cm

A temperature compensation of the conductivity value measured is carried out automatically by the temperature sensor integrated into the conductivity electrode, within a temperature range of 0 °C to 100 °C, with an adjustable temperature coefficient of 0 .. 4 % per °C. Reference temperature is 25 °C.

Temperature coefficients

Temperature coefficients with conductivity measurement:
Important – frequently misunderstood and often neglected
A solution's conductivity will change according to temperature. With increasing temperatures, the measured solution's conductivity will increase, too. To achieve meaningful measuring results, the value displayed is compensated to 25 °C. In other words, the display is always converted to a solution temperature of 25 °C. The temperature coefficient which the displayed value is compensated with is expressed as %/°C. Unfortunately however, different solutions also have different temperature coefficients. To achieve an exact display, the measuring device will have to be adjusted to the temperature coefficient of the current solution. The average temperature coefficient for dialysates is 2.07 %/°C.

For naturally occurring solutions, a value of 1.97 %/°C is frequently used. Many measuring devices not specially tailored to dialysis will use this value. The calculation below shows the drastic effects of an incorrect temperature coefficient.

To create perfect chaos, different dialysis machine manufacturers will also use different temperature coefficients in their machines.

Baxter	2,20%/°C
Braun	2,00%/°C
FMC	2,10%/°C
Gambro	1,80%/°C
Hospal	2,07%/°C
Mesys Miro	12,00%/°C
Nikkiso	
Bicarbonat	2,02%/°C
Gesamtleitfähigkeit	2,05%/°C

Example calculation for an incorrect temperature coefficient, using a dialysate with a temperature coefficient of 2.07 %/°C.

This necessarily leads to the following conclusion:
Set your measuring device for each measurement to the temperature coefficient the dialysis machine uses for compensation.

Setting the temperature coefficient

The HDM97 enables you to easily set different temperature coefficients. You can choose between eight fixed settings and a variable value. The fixed values are values of frequently used dialysis machines. The variable value can be set to any required value.

Selecting a temperature coefficient

If the HDM97 is in the conductivity measuring mode, pressing the conductivity function key once again will change over to the temperature coefficient setting mode.
Changing to this mode will be initiated briefly by displaying 'tC'. Both the conductivity function key LEDs will flash. The temperature coefficient currently set will be displayed for ca. five seconds. In case no other key is pressed during this time, the HDM97 will automatically return to the conductivity measuring mode.
In case any of the two arrow keys is pressed within these five seconds, each time the key is pressed, the pre-set temperature coefficients will be displayed one after the other. By pressing the KAL key, the selected value can be accepted for further conductivity measurements.
The value set for the temperature coefficient by the user will be displayed twice when using the selection procedure above. When this value is displayed for the second time, a short acoustic signal sounds, and the KAL key LED will also flash. After pressing the KAL key, the variable temperature coefficient may be changed to any value within a range of 0.00 to 4.00 %/K. By pressing the KAL key once more, the set value is accepted. All settings will be saved permanently and are still present even after switching the HDM97 off.

It is possible to cancel the temperature coefficient setting mode at any point described above by pressing the channel selector keys. Any values possibly changed will not then be saved.

Pressure measurement

By pressing the function key mmHg/kPa, you will enter the pressure measuring mode. The pressure value measured is displayed with no digits after the decimal point for pressure unit mmHg, and with one digit after the decimal point for pressure unit kPa.
The internal pressure sensor is suitable for a pressure measuring range of -750 to +1600 mmHg, or -100 to +199.9 kPa. In case the measuring range is not observed, a range message OFL appears on the display, indicating that the measuring range has been exceeded.
Depending on the drift of the pressure sensor, the pressure display may vary slightly in the zero point. The display can be set to zero using the balancing function. However, pressure must not be applied to the sensor when doing so. This can be safely achieved by leaving the pressure measurement connection point unoccupied. The zero point for balancing purposes will then be the ambient pressure.

Unit

In the pressure measurement, repeated pressing of the function key also enables the unit to be changed as required between mmHg and kPa. The values are converted if the unit is changed. Recalibration is not necessary.

Balancing an offset

Balancing must be carried out as follows
Press the function key *mmHg/kPa* and hold it down, then press the Cal key. The display is then counted backwards from 5 to 0. Keep the Cal key pressed until an audible check-back message is issued and a zero appears in the display.

If the Cal key is pressed for longer, there is a possibilitiy of standard values being accepted. Read the section *Standard Values* for details.
If the Cal key is released prematurely, the balancing is ended without relevant values being accepted. The error message E22 appears in the display. The unit is now in Balancing mode, which is indicated by the LCD integrated in the Cal key flashing. If the displayed pressure measurement value has reached a stable state, balancing is performed by keeping the Cal

key pressed until an audible check-back signal is issued and until a zero appears in the display. The display is counted backwards from 5 to 0. If the Cal key is released prematurely, the error message E33 appears. You now have the possibility of continuing the balancing the operation. If the Cal key is again released prematurely, the error message E44 appears. No balancing takes place. The unit then exits Balancing mode and returns to the pressure measurement.
Completed balancing is acknowledged in the display with CAL. The unit then exits Balancing mode and returns to the pressure measurement.

pH measurement

Pressing the function key pH takes you into the pH value measurement mode. The measured pH is displayed with two decimal places. The combined electrode used for the pH value measurement is suitable for a measurement range of 0 to 14. If the measurement range is not observed, the range message OFL, signaling that the measurement range has been exceeded, appears in the display. If error message E11 appears in the display instead of the pH value and if an audible signal sounds at the same time, no combined electrode has been recognized. The reason for this error message can be an incorrectly inserted or faulty combined electrode.

Temperature compensation, pH measurement

For automatic compensation of the pH measurement, the unit offers the possibility of measuring the solution temperature via the temperature sensor. If no temperature sensor is connected, a solution temperature of 20 °C is assumed.

Fundamental information about pH-measurement

For the measurement of the pH-value a combined electrode is used. pH electrodes are combinations of one reference electrode and one measuring electrode in a glass tube.
The pH-value in the dialysate is measured by an unbreakable pH-electrode. The glass body is protected with a plastic coat and due to the jelly-electrolyte-filling maintenance-free. This electrode` s diaphragm must be stored in 3 mol/l KCl-solution. The protection hood must be refilled every three to four weeks.

For pH-measurement in untreated desalinated water a particular electrode is necessary. This glass electrode is optionally available and has a 1 mol/l KCl reference electrolyte. The diaphragm of this electrode must be stored in 1 mol/l KCl-solution.
Before usage the electrode must be checked on exterior damage and glass crash. Crusts caused by leaking electrolyte can be removed easily by rinsing. The sample volume should be 100 ml dialysate or 1 l of untreated water. The sample volume is being led to the bottom of the vessel with a tube or hose for coming as little as possible into contact with air. The pH-value must be measured immediately in the same vessel. You have to make sure that the display stabilizes before the value is read. In stirred solutions the response rate is faster, the value, however, must be measured at resting fluid.
The pH-electrode must be dabbed only and never rubbed dry. The rubbing destroys the jelly layer on the glass surface which results in a longer response time of the electrode.
Due to the special electrode, for pH-measurement in untreated water further points need to be paid attention to: air bubbles in the membrane space of the electrode can be removed easily by shaking movements similar to a clinical thermometer. The reference electrolyte in this electrode can be refilled. Make sure that the refill cap is sealed with the rubber hood.
The level of the reference electrolyte must always be sufficiently large.
Before the measurement the rubber hood must be removed, since otherwise no internal pressure compensation occurs. On the lower shaft of the electrode a plastic part is to be found which must always remain freely movable on the shaft. If the mobility of the plastic part should be restricted it can be released by rinsing with lukewarm water. This plastic part conceals an opening in the glass which must be covered always. Pressure and currents have considerable influence on the pH-measurements. Therefore, it is necessary to accomplish the pH-measurement in a resting solution at environmental pressure.

Charging state, battery

The battery must be charged if *LOW BAT* appears in display at the top left. The processer-controlled charging occurs when the power supply unit is connected. There are two charging modes: Rapid charging and floating charging. The LCDs above the key I indicate this state. Green stands for floating charging, while the red LCD indicates rapid charging.A maximum of 2.5 hours are required for complete charging.

For safety reasons, never operate the measuring unit with a charging unit connected to a dialysis machine to which a patient is also connected.

Calibrating of the unit

Calibration

Calibration of the individual channels is slightly different.
The pH measurement is calibrated at 2 points.
The conductivity is calibrated by measuring the cell constant. Only one calibration point is necessary for this.
The temperature and pressure measurements are calibrated exclusively via the program *HDMCal,* in conjunction with the PC.
If at any point during the program sequence, during calibration of pH measurement or during the calibration of the conductivity on the unit, you are unsure whether you have correctly entered all values, you can exit the calibration procedure in a targeted way. After you have done so, no calibration is performed and you can start again from the beginning. The necessary steps for exiting the relevant calibration procedure are described in detail in the Calibration, pH measurement and Calibration, Conductivity Measurement sections.

If a calibration is incorrect, you have the possibility of accepting the standard values for every measurement mode. Refer to the Standard Values section for details.

Calibration, temperature measurement

The temperature measurement is calibrated exclusively via the program *HDMCal* in conjunction with a PC.

Calibration, conductivity measurement

In order to avoid incorrect measurements which can occur as a result of deposits on the electrode after extended use and which can influence the cell constant, it is necessary to calibrate the conductivity measurement. However, before doing so you must ensure that the temperature is calibrated. In the event of heavy contamination of the electrode, cleaning with a 10% citric acid solution is recommended.
We recommend that you check the calibration once each month.

Perform calibration as follows

Press the function key *mS//µS* and keep it pressed, then press the Cal key. The display is counted backwards from 5 to 0. Keep the Cal key pressed until an audible check-back signal is issued and zero appears in the display.

If the Cal key is kept pressed for longer, it is possible for the standard values to be accepted. Refer to the section Standard Values for information.

If the Cal key is released prematurely, the calibration is terminated without relevant values being accepted. The error message E22 appears in the display.
The unit is now in calibration mode, and this is indicated by the LCD integrated in the Cal key flashing. *13.63 mS/cm* appears as a reference solution value in the display. This can be changed with the arrow keys in a range 10 to 15 mS/cm, depending on the reference solution being used. Calibration should be performed for measurements in dialysis in a range of 13...14 mS/cm and the reference solution should have a temperature of exactly 25 °C (± 0.1 °C).
Pressing the function key *mS/µS* allows the display value to be changed between the reference solution and the measured conductivity value. The temperature of the reference solution can be displayed by pressing the function key °C.
If the displayed conductivity measurement value has reached a stable state, keeping the Cal key pressed performs the calibration until an audible check-back signal is issued and a zero appears in the display. The display is counted backwards from 5 to 0 in this case. If the Cal key is released prematurely, the error message E33 appears. You now have the possibility

of continuing the calibration. If the Cal key is again released prematurely, the error message E44 appears. No calibration is performed. The unit then exits Calibration mode and returns to the conductivity measurement.
Completed calibration is acknowledged in the display with CAL and the cell constant determined is then displayed for approximately 2 seconds. The unit then exits Calibration mode and returns to the conductivity measurement.
If a calibration is not ended with the display CAL, with the error message E66 appearing instead, no permissible cell constant was determined. The cause can be, for example, an incorrectly set value for the reference solution. You then have the possibility of continuing the calibration procedure or exiting it in accordance with the diagram shown.

When calibrating the conductivity, work only with fresh reference solutions. Do not return used solutions to the storage bottle. Keep the solutions in a cool place.

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Calibration, pressure measurement

Calibration of the pressure measurement is performed exclusively via the program *HDMCal* in conjunction with a PC.

Calibration, pH measurement

We recommend inspection of the calibration before each measurement. Keep two buffer solutions ready. Both buffers should not be more than two activity decades apart. Choose, for example, pH6 and pH8. Carefully remove the protective cap before performing the measurement. Rinse the measuring chain with distilled water and dab it dry before immersing it into the buffer. If necessary, also rinse the temperature sensor, dry it and put it into the measuring beaker.

Please also read the fundamentals in the pH measurement section.

Temperature compensation pH measurement

For automatic temperature compensation for the pH measurement, the unit offers the possibility of measuring the solution temperature via the temperature sensor of the conductivity electrode. If no temperature sensor is connected, a buffer solution temperature of 20 °C is assumed.

Perform the calibration as follows

Press the function key *pH* and then keep the Cal key pressed. The display is counted backwards from 5 to 0. Keep the Cal key pressed until an audible check-back signal is issued and zero appears in the display.

If the Cal key is kept pressed for longer, there is a risk of the standard values being accepted. For details read the section Standard Values.

If the Cal key is released prematurely, the calibration is ended without relevant values being accepted. The error message E22 appears in the display.
The unit is now in Calibration mode, indicated by the LCD in the Cal key flashing. The pH value 7 appears in the display. This can be changed to the buffer solution being used with the arrow keys in a range of 1-14 in unit steps.
Pressing the function key *pH* enables the display value to be changed between the set buffer solution and the measured pH value. The buffer solution temperature can be displayed by pressing the function key °C.
If the displayed pH value has reached a stable state, calibration is performed by keeping the Cal key pressed until an audible check-back signal is issued and a zero appears in the display. The display is counted backwards from 5 to 0. If the Cal key is released prematurely, the error message E33 appears. You now have the possibility of continuing the calibration. If the Cal key is again released prematurely, the error message E44 appears. No calibration is performed. The unit then exits Calibration mode and returns to pH measurement.
Acceptance of the values is acknowledged in the display with P1. The combined electrode is then immersed into the second buffer solution. The further procedure is identical to the one described above. Completed calibration is acknowledged in the display with *CAL* and the gradient measured is then displayed in % for approximately 2 seconds. If the gradient is less than 85%, the combined electrode may be worn out and must be replaced by a new one. The unit then exits Calibration mode and returns to pH measurement.
If a calibration is not ended with the display *CAL* and if the error message E77 appears instead, 2 identical values have been entered for the buffer solution. You then have the possibility of continuing or exiting the calibration procedure in accordance with the diagram shown.

Standard Values

If a calibration is incorrect, you have the possibility of separately accepting the standard values for each measurement type installed in the unit during production.

Use this function only if you are fully aware of its effects, because your calibration values will otherwise be lost.

Accept the standard values as follows.
Press the function key of the measurement type whose calibration values are to be replaced by the standard values and then keep the Cal pressed. The display is counted backwards from 5 to 0. If the Cal key is released prematurely, the error message E22 is displayed. The unit returns to the previously set measurement type. Counting backwards from 50 to 0 in increments of 10 then occurs. Keep the Cal key pressed until an audible check-back signal is issued and a zero appears in the display after the backward-counting in increments of 10. If the Cal key is released prematurely in this counting mode, you are in Calibration or Balancing mode, depending on the measurement selected. You can exit this mode by pressing the CAL key. If you do this, the display is counted backwards from 5 to 0. If the Cal key is released before zero is reached, the error message E33 appears. If the Cal key is then pressed again and prematurely released before reaching zero, the error message E44 appears. The standard values are not accepted. The unit exits Calibration or Balancing mode and returns to the previously set measurement mode.
If you are in the Temperature measurement mode, the outlined steps for exiting the mode are not necessary. Merely the error message E55 is displayed. The unit then returns to Temperature measurement.
Acceptance of the standard values is acknowledged in the display with CAL. The accepted standard values are valid immediately. The unit then leaves Acceptance mode and returns to the previously set measurement mode.

Maintenance and care of the HDM97

Generally the HDM97 can be considered as an easy-care instrument. Like at all measuring instruments there is a minimum of maintenance and care necessary to ensure that all functions work flawlessly.

For safety reasons never use the HDM97 with connected battery charger on a dialysis machine to which a patient is connected.

Operate the instrument only in a dry environment, and do not touch it with damp hands. Ensure that no fluids intrude into the interior of the device, or into the sockets at the front. If this ever happens, open the device and remove the batteries. Sink the whole device into a vessel with distilled water over night. Afterwards, dry the HDM97, and send it to the producer for repair.
There are no parts in the HDM97 which you can repair yourself. Please, turn to our technical support at evident malfunctions that can not be removed by a new calibration of the device,. If the device should show any damages, or malfunctions by moisture influence, send it to the producer for repair.

Storage

Keep the device at a dry place. Suitable is, for example, the original packaging in which you have received the HDM97, or the carrying case offered by IBP as accessory. If you do not use the device over a longer period of time, you should connect it to the included charging device about every two weeks for one hour to avoid exhaustion of the installed batteries.

Cleaning

Never clean the device with any fluids! In case of pollution you can wipe the surface of the HDM97 with a dry and clean cloth.
For measurements in the lower conductivity range the cleaning of the conductivity / temperature measuring cell is recommended. Remove water-soluble substances by rinsing with de-ionized water, fats and oils with warm water and household dish washing detergent. Lime and hydroxid crusts can be solved by 10 per cent acetic acid. In each case, the measuring cell needs to be washed with de-ionized water after the cleaning.
Basically, the conductivity measuring cell does not decay. Particular measuring media (for example, strong acids and caustic solutions, organic solvents), or too high temperatures shorten the service life considerably, and/or lead to damages.

Caring for the conductivity / temperature electrode

Thorough cleaning of the electrode is particularly important for measuring low conductivities.
Water-soluble substances must be removed by rinsing with deionized water. Remove lime desposits with a 10% solution of acetic acid. To do this, immerse the electrode in the solution for 24 hours, then rinse it thoroughly with deioinzed water. Do not touch the electrode surface with your fingers. If necessary, clean the surface with acetone.

Calibration intervals

In the delivery state each device is newly adjusted. To assure a reliable function of the HDM97, the different measuring channels have to be calibrated at fixed intervals to examine their precision. This can be done by measuring known sizes, for instance, standard solutions, or proof voltages. If the measured values should deviate from the below indicated permissible limits, a new calibration of the instrument is necessary. We recommend the following intervals for the examination:

pressure measurement:	once a year,
conductivity measurement:	once a month,
temperature measurement:	once a year,
pH measurement:	before each measurement.

If for individual measuring channels the function *adjust reset* was used, then a new calibration is necessary for these channels.
To handle the calibration, please read the individual sections in which the calibration is described for the different channels.

Write down your calibration values and keep them until the next calibration. In case of damage, a calibration protocol can be important for the fault location.

If the calibration has been done by the IBP, a sticker will be put on showing the date of the next calibration necessary.

For liability reasons you should not carry out the calibration yourself. If IBP has been charged with the calibration, you will receive a calibration certificate which documents the calibration results.

Allowed limits

measuring channel	*measuring range*	*allowed limits*
pressure	-700...+1600 mmHg	± 2 mmHg
	-100 + 199.,9kPa	± 0,3 kPa
conductivity	0...19,99 mS/cm	± 0,03 mS/cm
temperature	0...80 °C	± 0,1 °C
	80...100 °C	± 0,2 °C
pH	pH 0 ... pH 14	± 0,1 pH

Specifications for the HDM97

Conductivity

0...19,99 mS/cm in 4 ranges, quadro-pole-electrode, temperature compensation with 2,07 % per °C, temperature sensor integrated in the measuring cell, reference temperature 25°C,
precision better than 0,25 % of full measuring range
Temperature range, adjustable from 0.00% to 4.00% per °C

Temperature

0...100°C, resolution 0,1 °C,
precision better than ± 0,1°C
probe integrated in combined conductivity / temperature electrode

Pressure measurement

-700...+1600 mmHg, precision better than 0,5 % of full measuring range, connection over tube nozzles

pH-measurement

Electrode is not included in the delivery extent, pH 0...14, resolution 0,01, precision better than 0,2 pH, temperature range 0...60 °C, temperature calibration manually or via probe in combined electrode.

Power supply

Battery rechargeable with 12 V, 450 mA DC,
Operating time, depending on operating mode, approx. 19.5 hours

Size

approx. 210 x 105 x 50 mm

RS-232-Interface

Pin occupation of the RS-232-interface

Pin No. HDM97	Signal	Pin No.	Signal computer
2	RxD >	3	TDX
3	TxD >	2	RXD
5	GND >	5	GND

Interface parameters

The following interface parameters are fixedly adjusted at the HDM97

Baud rate	**9600**
Parity	**None**
Data bits	**8**
Stop bit	**1**

HDM97 Commands

General:

1 .All values like : <12.34>
2. Device-Number: xx
3. Conductivity range: y
4. Inadmissible commands call forth ‘ERROR’
5. 9999.99 > no Sensor

Activate Communication:

Host : HDM97xxSTA<cr>
HDM: OK<cr><lf>

Deactivate Communication:

Host: HDM97xxSTO<cr>
HDM: OK<cr><lf>

New Device-Number:

Host : HDM97xxDxx<cr>
Device-Nummer nur von 1 ..32
HDM: OK<cr><lf> oder ERROR<cr><lf>
OK > Device-Nummer wird übernommen.
ERROR > Device-Nummer wird nicht übernommen.

Conductivity Measuring Range:

Host: HDM97xxLFy<cr> y = 1 > 0 - 20 µS
2 > 0 - 200 µS
3 > 0 - 2 mS
4 > 0 - 20 mS
HDM: OK<cr><lf> oder ERROR<cr><lf>
OK > Bereich zulässig
ERROR > Bereich unzulässig

Deactivate Conductivity Measuring Range:

Host: HDM97xxLFN>

HDM: OK<cr><lf>

Give out Units:

Host: HDM97xxUNI<cr>

HDM: <µS oder mS><cr><lf>
<°C><cr><lf>
<kPa><cr><lf>

Give out values:

Host: HDM97xxVAL<cr>

HDM: <Leitfähigkeitswert><cr><lf> [mS/µS]
<LF-Strom (indirekt)><cr><lf> [mV]
<LF-Spannung><cr><lf> [mV]
<Temperatur><cr><lf> [°C]
<Temperatur - ADC><cr><lf> [mV]
<Druck><cr><lf> [kPa]
<Druck - ADC><cr><lf> [mV]
<PH><cr><lf>
<PH - ADC><cr><lf> [mV]

Functional messages

Error messages

During calibration or measurement, a double audible signal and a message in the LCD display indicate faults to the user.

E11 No sensor recognized
E22 Calibration call-up not permissible
E33 Calibration error (first warning)
E44 Calibration error (calibration is ended)
E55 Temperature calibration not possible
E66 Cell constant cannot be identified
E77 Identical buffer solutions
E88 Measurement in the selected measurement mode not possible due to invalid calibration values.
In order to be able to commence measurement operation, you have the possibility of accepting the standard values or performing recalibration.

Range message
OFL Measurement range exceeded

Calibration message
CAL Calibration values safeguarded
P1 first pH values accepted

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